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SERVICING VIDEO AMPLIFIERS

The video amplifier is a key link in any television receiver. Situated between the video detector on one end and the picture tube and synchronizing circuits on the other, this amplifier is called upon to pass the entire composite video signal — all frequencies between 60 cycles and 4 megacycles. Picture elements, sync pulses, and blanking pulses must be transmitted by the video amplifier. In TV receivers of the intercarrier type, sound information also passes through the video amplifier.

The basic circuit arrangement of the video amplifier as a receiver channel with very wide band pass does not change, although the final circuitry may vary somewhat in receivers of different manufacture. Some sets employ a single video stage, while others use two or more. Figure 1 shows the video circuit of Hallicrafters Model 513 receiver. Here, a 6AU6 1st video amplifier after the video detector is followed by a 6AQ5 video output stage. The signal output is sync negative and accordingly is applied to the picture tube grid. If an odd number of video stages were employed, instead of the even number shown in Figure 1, the output signal phase would of course be reversed and the signal would be applied to the picture tube cathode.

Both series and shunt peaking are employed in the video channel shown. Inductors L_3 and L_5 are the series peaking coils, while L_4 and L_6 are shunt peaking. Note that each of these coils is shunted by a fixed resistor (R_3, R_4, R_5, and R_6) for Q reduction to prevent overemphasized high-frequency peaking. Frequency response of the video

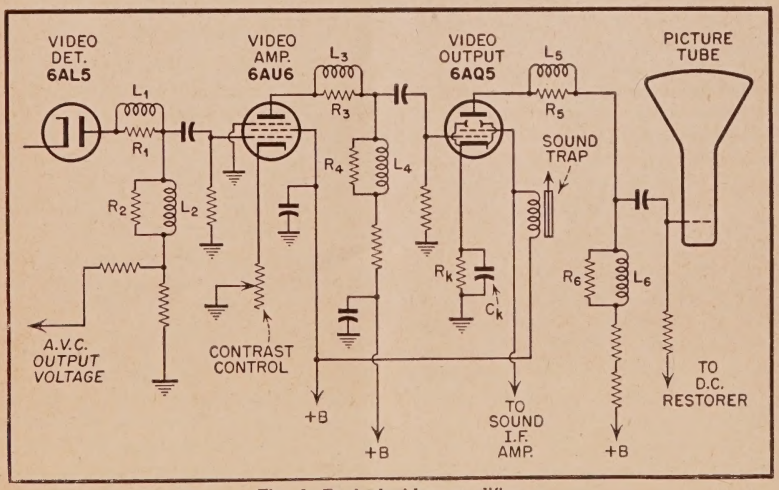

Fig. 1. Typical video amplifier.

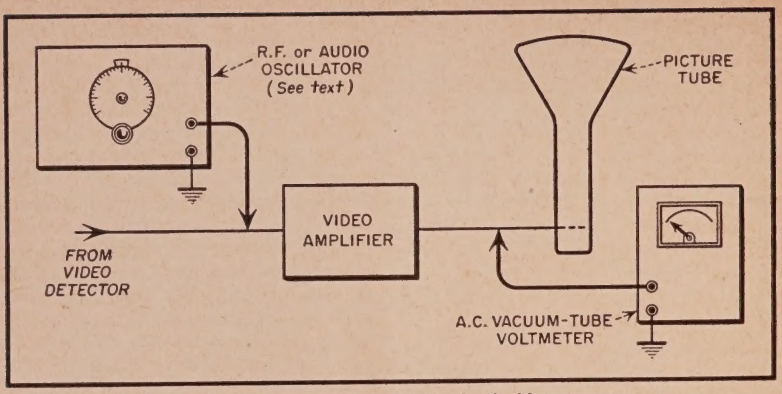

Fig. 2. Setup for point-by-point check of video response.

channel throughout the desired wide pass band is governed by the circuit constants, especially the characteristics of the peaking coils, shunting resistors, plate load resistances, and the 6AQ5 cathode R-C network, R_kC_k. Gain of the video amplifier is controlled by the variable cathode resistor in the 6AU6 stage. This component is the *contrast control* of the receiver.

Since the video amplifier must handle a wide range of frequencies, the common tendency is to think of its response as perfectly flat from zero to 4 megacycles. A sharp drop-off to zero is expected at 4.5 Mc. to prevent sound channel interference. But few video amplifiers outside of the laboratory actually exhibit such response. Experience shows that a sharp, live picture is produced when the response is peaked toward the high-frequency end of the pass band, just before the 4.5 Mc. drop-off. An absolutely flat curve usually does not give a sharp picture. The best practical response curve more nearly resembles Figure 5(B).

When checking TV receivers for overall performance, the video amplifier response must be considered. Previous literature has described several times the use of a standard test pattern to check bandwidth of the receiver. When no pattern is being telecast, or when the front end of the receiver is inoperative, the service technician must use instruments to check video amplifier response. This article explains both point-by-point and visual methods of checking.

Point-by-Point Method

The point-by-point method of checking video amplifier response is the same techinque employed for point-by-point determination of an audio amplifier response curve. The only difference is that both radio and audio frequencies must be used in checking the video amplifier.

Figure 2 shows the instrument setup for making this test. An audio oscillator is required for the low frequencies, and an unmodulated RF oscillator or signal generator for the high frequencies of the video pass band. Both oscillators must be capable of delivering 0.1 volt r. m. s. output. An AC vacuum tube voltmeter, having good accuracy at 4 megacycles, is used as the indicator.

The output signal from the oscillator is fed into the video channel of the receiver directly after the output load circuit of the video detector. The VT voltmeter is connected to the grid of the picture tube. (In some sets, the video signal is applied to the cathode of the picture tube, and in such cases the VT voltmeter also must be connected to the cathode).

A constant 0.1-volt signal is applied to the video amplifier input, and the corresponding output voltage is measured throughout the video range. As many test frequencies as possible are used. In this way, the video response curve (output volts plotted against frequency) may be determined. Peaks, dips, and flat portions will be readily apparent.

The following test procedure is recommended: (1) Set up the equipment as shown in Figure 2. Switch-on the receiver and instruments and allow at least 15 minutes warmup time. (2) Set the receiver contrast control at maximum and the brilliance control at about ½ maximum. Disconnect the antenna or detune the receiver from any channel being used for telecasting at the time of the test. (3) With the audio oscillator connected to the video amplifier input and set to 60 cycles, adjust the oscillator output voltage *exactly* to 0.1 volt. (4) Record the VT voltmeter reading at the picture tube. (5) Set the test frequency to 100 cycles, re-set the signal voltage to 0.1 v., and note the new VT voltmeter reading. (6) Repeat at each 100-cycle point from 100 to 1000 cycles, then at each 1000 cycles to 10 kc., and finally at each 10 kc. to 50 kilocycles. (7) Next; substitute the unmodulated RF signal generator for the audio oscillator and repeat the entire procedure (with constant 0.1-volt output signal) at each 100 kc. point up to 1 Mc., and then at each 1-megacycle point to 5 Mc. It may be advisable to check several closely-spaced points around 3 to 4 Mc., in order to detect sharp peaking of the curve in this region.

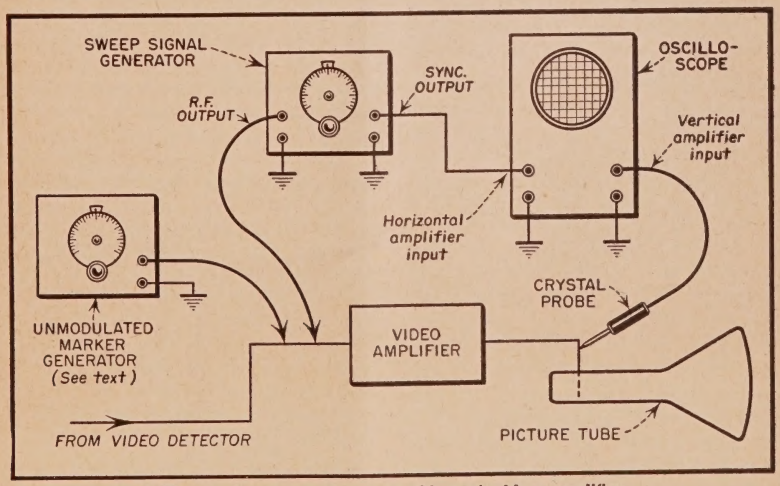

Fig. 3. Setup for visual checking of video amplifier.

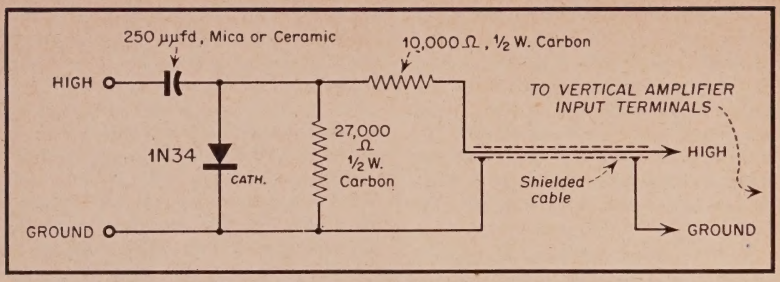

Fig. 4. Circuit of oscilloscope test probe.

Voltage gain of the video channel may be determined simply by multiplying the output VT voltmeter reading by 10. Thus an indication of 10 volts indicates a voltage gain of 100, since a 0.1-volt input signal is used.

Spot Check Method

A complete point-by-point check, such as just described is exceedingly laborious and time consuming. Except in cases of bad video trouble, the service technician may not be able to devote the time required for a complete frequency run of this type. A simpler, faster spot check involving fewer frequencies will be adequate in most instances.

The same technique and instruments are used as described in the previous Section. However, the spot frequencies for testing should be 60, 100, 500, 1000, 5000, 10,000, 25,000, and 50,000 cycles; 100, 500, and 1000 kc.; and 2, 3, 4, and 4.5 Mc. Here, as in the previous case, it will be desirable to check at several closely-spaced frequencies between 3 and 4 megacycles, in order to detect peaking of the response curve in this region.

The Editors believe that the 15 spot frequencies will give a good indication of video amplifier performance. Some service technicians report success when using even fewer test frequencies. One correspondent, for example, uses an unmodulated RF signal generator for spot checks at 50 kc.; 1, 3, and 4.5 Mc.; and the 400-cycle separate output of the same signal generator for a single-frequency check in the audio end of the video range.

Visual Method

For speed and convenience, the visual method of checking frequency response has no equal. The entire response curve is reproduced instantaneously (as far as the eye is concerned) on an oscilloscope screen. Figure 3 shows the instrument setup for visual checking of video amplifiers. The sweep signal generator must have a sweep width of at least 5 megacycles and must supply sync output voltage for the oscilloscope. The marker generator is used to produce frequency-identifying pips of the response curve viewed on the oscilloscope screen. For marking purposes, an audio oscillator will be required for frequencies up to about 50 kc., and an unmodulated r. f. signal generator for frequencies from 50 kc. to 5 Mc. A crystal-type demodulator probe must be provided for the vertical amplifier input of the oscilloscope. The circuit of a satisfactory probe of this kind is shown in Figure 4.

The following procedure is recommended for checking by the visual

method: (1) Set up the equipment as shown in Figure 3. Switch-on the receiver and instruments and allow at least 15 minutes warmup time. Set the receiver contrast control to maximum and the brightness control to about ½ maximum. Disconnect the antenna or detune the receiver from any channel being used for transmissions. (2) Turn down the marker generator output to zero. (3) Prepare the oscilloscope: (a) switch-off the internal sweep oscillator, (b) set the SYNC switch to INTERNAL, (c) Set the HORIZONTAL and VERTICAL GAIN controls at about ½ maximum, (d) set the SYNC AMPLITUDE control at about ¾ maximum. (4) Set the sweep generator frequency to 2 Mc. and the sweep generator output voltage to approximately 0.1 volt. Under these conditions, the output frequency will be swept from zero to 4 Mc. Adjust the phasing control of the sweep generator and the horizontal and vertical gain controls of the oscilloscope to give a single-traced, clear response curve on the oscilloscope screen. (5) Since no blanking is employed, two complete curves (See Figure 5-C) probably will appear. By adjusting the horizontal gain control and horizontal beam centering control of the oscilloscope to spread the pattern across the screen, the extra curves may be displaced off the screen and a single curve (See Figure 5-D) made to fill the entire screen. (6) To identify frequencies at various points along the response curve, turn up the output of the marker generator and tune upward from its lowest frequency. Note that a beat-note pip, such as is shown in Figure 5-E, will appear somewhere on the curve. The frequency represented by this point on the curve then may be read from the dial of the marker generator. Always use the weakest marker signal which will produce a visible pip on the curve. Strong marker pips distort the response curve and give a false indication of amplifier characteristics. (7) After reaching the upper frequency limit of the audio oscillator, remove this instrument from the setup, and connect in its place an unmodulated RF signal generator. The latter then may be used as a signal marker up to the top end of the video response curve.

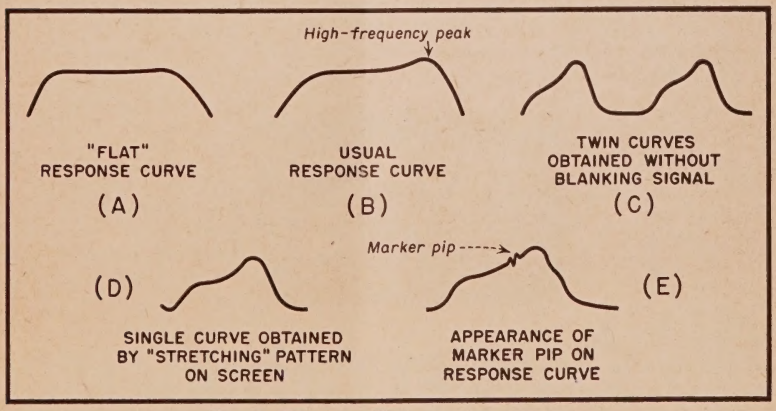

Fig. 5. Video amplifier response curves.

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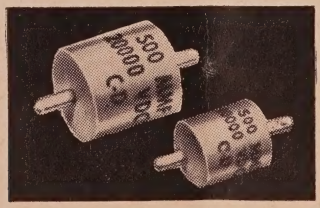

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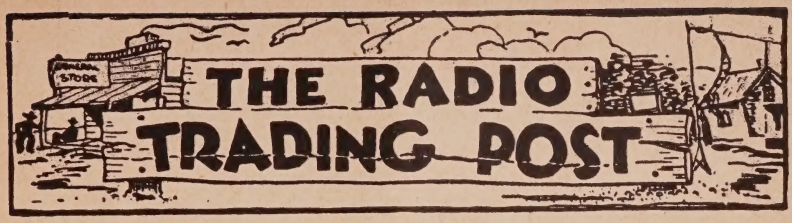

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FOR SALE—Supreme 542 multimeter in metal case with protective metal cover for meter, d.c. volts to 1500, a.c. to 600V. Best offer. Louis Fialkoff, 143-48 41 Ave., Flushing L. I., N. Y.

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FOR SALE—Riders vols. 1-12; Supreme 1-14; auto radio service power pack; sig. gen.; tube tester. Also other equip and technical books. William G. Bonnot, R. R. 3, Jefferson City, Mo.

SELL OR TRADE—Masco 25 watt amplifier with two 25 watt speakers for good NC173 or similar receiver. Also have complete radio servicing and communications course by NRI. Make an offer. J. D. Knight, 905 W. Morton, Denison, Texas.

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TRADE—National 1-10 rec. with power supply, $35; Miller High Fidelity AM tuner, $40. Want test equipment, oscilloscope, VTVM, or sig. gen. Lt. R. G. Kuck, USMCR, MCEB, Marine Corps Schools, Quantico, Va.

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FOR SALE—Silvertone 3-way portable with batteries, model 101 .823-1, phone jack in rear, $25. Or what have you? William Hintz, R. 4, Hutchinson, Minn.

FOR SALE—200 popular scarce type receiving tubes. Best offer. Barney Loebe, Grenada, Mississippi.

SWAP—Have many radio magazines. Want home-workshop magazines. Send your list. Mine will follow. F. L. Revie, Box 411, Lemon Grove, California.

TRADE—Have surplus known brand 6T8 tubes. Will exchange for 6BG6, 5V4, 5U4, 1B3 tubes. List value. Write for details. Ben Marconi, 120 Gatling Pl., Brooklyn 9, N. Y.

FOR SALE—Ex German Navy transceiver, first class cond., complete with mike, cables, power pack for 110/220 a.c. and 12V batt., extern. xtal QRG control pack, range in CW and Phone 2-5 Mc/s. perfect. Hans Wahnschaffe, Hamburg-Blankenese, Ferdinandshohe 11, Germany.

SELL OR TRADE—Lab type 10 tube tester, $20. Also have 16mm sound movie films and tubes. Harold Wurm, 1009 W. Barnes Ave., Appleton, Wis.

SALE OR TRADE—Eico 425 5" scope, $60; ¼" elect. drill, $8. Want 250 watt ISO TRAN and "A" batt. eliminator. Dale Henry, 1915 El Cajon Blvd., San Diego 4, Calif.

SALE OR TRADE—Zenith 7G605 Trans-Oceanic portable; Hammarlund Comet Pro short-wave receiver; automatic record changer, ten or twelve inch; Riders Manuals. Want Tweeters for Scott XXX; Super Pro, any condition; or what? Glenn Watt, 415 West First, Chanute, Kans.

WANTED—Precision model E-200-C signal generator in A-1 shape, and one small portable Diathermy outfit in good shape. Cash for same. Chas. S. Brotzman, 173 Main St., Mexico, Maine.

WANTED—Good used "S" meter for Hallicrafters S-20R. State condition and price. Dorsey Lehman, Radio Shop, Culbertson, Nebr.

FOR SALE—487 diagram and instruction sheets covering all models record players, FM-AMtuners, intercoms, tape and wire recorders from 1947 to 1950. Also PA systems. Parts list included with every diagram, $116.80. John Keller, 411 South Market Street, Martinsburg, Pa.

TRADE OR SELL—Ashaway or Humphrey Spinning reels for late radio tubes. Also have 35mm camera, battery type tube bargains, B-flat clarinet, and glass fishing rod. Want tubes or cash. Frank E. Popma, Orange City, Iowa.

FOR SALE—Heavy duty Philco power transformers, 6.3V filament; lots of hard to get tubes; all kinds of radio parts. State your needs. E. L. Somers Radio Service, North Somerset Avenue, Crisfield, Maryland.

TRADE—Packard Bell radio, PA system, recorder, playback, pushbutton control, with short wave band, in leather carrying case. Want communications rec. Albert H. Kaiser, 1973½ Hillcrest Road, Hollywood 28, California.

FOR SALE—National N.C. 46 high freq. receiver and speaker, excellent cond., $50. Russell M. John, Jr., RD 2, State Rd., New Castle, Delaware.

FOR SALE—Modern Radio Servicing by Ghirardi, $2.50; FM Transmission and Reception by Rider and Uslan, $2.50; TV Servicing by Manly, $2.50; Math. for Elect. and Radiomen by Cooke, $3.50; Radioman's Guide by Audel, $2.50. John Comstock Wellsboro, Penna.

WANTED—SX-42, speaker not necessary, in top condition. State condition, cost, and method of delivery. Frank McCafferty, 149 W. Godfrey Ave., Philadelphia 20, Pa.

TRADE—German Voigtlander Kodak No. 120, 3.5 lens, very compact. Want radio test equipment, or what have you? S. C. Constable, 633 Ave. "B" S.W., Winter Haven, Fla.

FOR SALE—Army surplus PU-8 gasoline motor driven generator unit, 110 volts, 1400 watts, 400 c.p.s., and 28 volts d.c., 400 watts, with spare parts, new condition, $100. S. J. Solms, 132 Franklin Turnpike, Ramsey, N. J.

TRADE OR SELL—Want 8mm movie equip., radio correspondence course, Linguiphone French course, and other items. Have radio gear to trade or sell. Send your list — I'll send mine. D. D. Bulkley, 405 Weaver Street, Larchmont, N. Y.

TRADE—Webster wire recorder model 80 in excellent working condition, a year old. Want disc recorder, or what have you? S. T. Jazowski, 335 17th Ave., Irvington 11, N. J.

FOR SALE—Dynamic microphone, electro-voice model 725, 30-10,000 cps, hi-impedance, output 53 DB, variable pick-up pattern, built-in on-off switch. Complete with 20 ft. low cap. cable and sturdy adjustable floor stand, never used, $20. N. Hulemark, 130 - 75th St., Brooklyn 9, N. Y.

FOR SALE—274 TV diagrams covering 929 models. Diagrams contain parts list, voltage and resistance measurements, alignment data. Plus 79 wiring diagrams covering 446 models, no service data 1946 to 1950. $215.50. John Keller, 411 South Market St., Martinsburg, Pa.

WANTED—Millen Grid Dipper, good condition. Prefer on swap basis. Have new 250th, tuning condenser, and filter condensers that go with it. Or what do you need? Molyneux, 53 Gulf St., Chickasaw, Ala.

WANTED—Test equipment for TV and radio service. Late models. Give full details and prices. Joseph Konecny, P.O. Box 4011, Jacksonville, Fla.

WANTED—Globe King, Lysco, 32V-2, SR-75, HT-9. Trade RCA 663, S-72, two 344-D, ART with a.c. sup., Amer. Variac 0-150V 20 amp., 0-220V 4.55 amp., 779B with sup., Bausch Lomb 6 x 30mm binoc., Webster portable Model 80-1 wire recorder. B. Armstrong, 18425 - 4th S. W., Seattle, Washington.

FOR SALE—Rider publications, all perfect: TV Manual No. 1, FM Transmission and Reception, Servicing by Signal Tracing, the Oscillator at Work, the Meter at Work, Vacuum Tube Voltmeters, Automatic Freq. Control Systems, Aligning Philco Recs. (2 vols.), Hour a Day (4 vols.), Philco TV Servicing. Everything, $20. P. Rosenblatt, Paterson Plank Rd., Carlstadt, N. J.

FOR SALE—RCA 1" CR oscillograph with built-in AF oscillator and attenuator, plus excellent RCA 2" interchangeable CR tube and operating manual, $18. Also G.E. 1/4 h.p. 115V d.c. motor with pump and shaft coupling, $9. M. P. Ross, 2420 Sedgwick Ave., University Heights 63, New York, N. Y.

FOR SALE—Hammarlund Super Pro, SP-400X. Three years old, used very little, excellent condition, matching speaker. Best cash offer, no trade, f.o.b. Bob Horst, 954 County Road B-2, St. Paul 8, Minnesota.

WANTED—CREI correspondence books on Radio Engineering, complete course. State condition, number of volumes and price. W. H. Smith, 115 Eastern Ave., Bellmore, L. I., New York.

FOR SALE—Supreme sig. gen. and freq. modulator, model 581; Supreme oscilloscope, model 535; Superior X-rayometer, VOM capac.; Superior model T-53 dynamic mutual conductance tube tester. Also 10 old radios. Robert Bilek, 10407 Grandview Ave., Cleveland 4, Ohio.

WANTED—AN/APR-4 recr., tuning units; ARC-1, ARC-3, TS-174/U, ART-13, other "TS-," radar, lab equip., manuals, tubes, etc. Give description and price. Charles C. Littell, Jr., Farhills Box 26, Dayton 9, Ohio.

WANTED—Several TV sets, 10" or larger, in operating condition. Cabinet condition immaterial. To be used for instructional purposes. State model, condition, and bottom price. School of Industrial Technology, 149 East 26th St., New York 10, New York.

FOR SALE—NRI signal tracer, model 33, new condition, $35. Or will trade for Precision E-200C sig. gen. and give $15 difference. Obern Vanover, Wise, Va.

WANTED—2, 3, 5, horsepower gas engine, in reasonably good condition, suitable for small farm equipment. Have radio and TV parts, test equipment, and Hallicrafter rec. H. Miller, 5030 Sprague Rd. E., Cleveland 9, Ohio.

WANTED—One of the better Scott receivers. Write full description, model, type, price. James H. Littig, Kasota, Minnesota.

FOR SALE—Model 502 Supreme tube and set tester, excellent condition, manuals and tube test sheets and tube adapters, $30 postpaid. Albert C. Hart, 207 N. Raymond St., Griffith, Indiana.

FOR SALE—Silicon Steel Strip, Trans. Grade 58, 3000# .003 x 1⅛" x coils, immediate delivery. N. E. Slavin & Co., 80 Federal St., Boston 10, Mass.

SELL OR TRADE—Sound projectors, 16 and 35mm sound films, test equip., amplifier 18W, lot of 85 tubes, other items. Want recorder, record changer, radios, guns, watches, etc. Jack Grant, Olney, Okla.

WANTED—Wheatstone bridge. Also will trade 3 phase 220 volt motor generator 250 amp. d.c. General Electric welder for best TV set offered. H. E. Roberts, RR 4, Wapakoneta, Ohio.

FOR SALE—Excellent rear seat speaker assembly, complete; Ford auto radio series, part No. 51A-18875 and 59A-18875, $4 f.o.b. Norfolk. Raymond H. Ives, 663 Kempsville Rd., Norfolk 2, Va.

FOR SALE—Superior Instrument Co., tube tester, model 450, instructions. This tester hasn't been used very much. First $25 takes it. Postpaid. Morton's Radio, P.O. Box 43, Potsdam, N. Y.

SWAP—Rider 1 and 2 for volumes later than No. 3. State condition. Mine are very good. H. A. Nickerson, 435 N. Main St., Sharon, Mass.

SWAP—FMETTE FM radio for service instruments. Blais' Radio Service, 282 Pleasant, Berlin, N. H.

WANTED—A 7" TV set for $25. I have a signal generator with a condenser checker which I will sell for $10 plus postage. Tunes from 100kc. to 6.5mc. M. Brown, 525 Penna. Ave., Elmira, N. Y.

FOR SALE—200 watt phone, CW, all band transmitter, custom built in floor cabinet. Sell to highest bidder over $100. Frank's Radio Lab., Box 252, W. Burlington, Iowa.

TRADE—BC 221C freq. meter, perfect shape complete with calibration books, spare set of matched tubes and crystal and converted to a.c. Want Meissner sig. shifter with NBFM or small commercial fone-cw transmitter. Henry A. Galbraith, 1101 East Franklin, Evansville, Indiana.

SELL OR SWAP—G.I. 78 r.p.m. recorder and playback unit. Want electronic test equipment. Make offer. Paul Schiffres, 1 Jennis Court, Brooklyn 26, N. Y.

WANTED—To buy or swap, new radio, TV, transmitting, and special-purpose vacuum tubes. Send detailed list for cash offer. What do you need? B. N. Gensler, 136 Liberty St., New York 6. N. Y.

FOR SALE—BC-412B oscilloscope in excellent condition. Best cash offer. N. I. Wolk, 1411 Avenue N, Brooklyn 30, N. Y.

SELL OR SWAP—Large list of test instruments and parts (electronic). List sent on request. Like to trade for complete enlarger or Speed Graphic type camera. M. J. Kolo, 9315 Brockton St., Detroit 11, Mich.

FOR SALE—Limited quantity of 70L7 radio tubes, $1.10 ea. postpaid. Also 78 r.p.m. record player, $5.50. Jones Radio Co., Box 93, Douglassville, Pa.

WANTED—Good K&E or P&E slide rule and Ciroflex or good camera. Will buy or trade for S-40 in excellent cond. Dan De Leon, 39-49 45th St., L. I. City 4, N. Y.

WANTED—Will buy radio and TV tubes by the lot. Also need dial scale for Silvertone chassis No. 110.454. Can use several 5 tube radio sets or kits, will swap. Ben's Radio, Dept. CD, North Tonawanda 2, N. Y.

FOR SALE—Precision 10-20P tube and set tester, latest roll chart, $80. Precision E-200C sig. gen., $45. Supreme model 574 Electronic set tester (VTVM), $45. All excellent condition. Milan Rafayko, 355 N. Limestone, Lexington, Ky.

FOR SALE OR TRADE—Radio shop with very good stock of hard-to-get tubes, in lively TV area, competition practically nil! Will sell for $1500, or trade for house trailor 22' or smaller, less than 5 years old. Radio Clinic, 215 E. Mich. Ave., Marshall, Mich.

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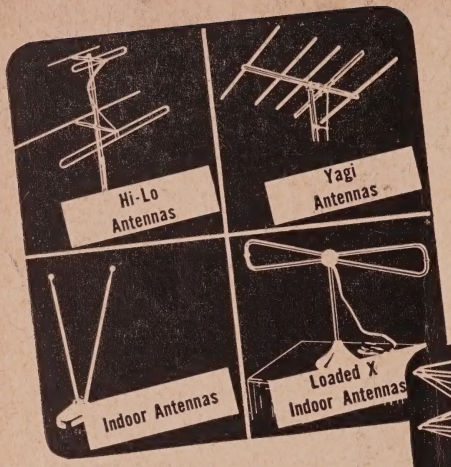

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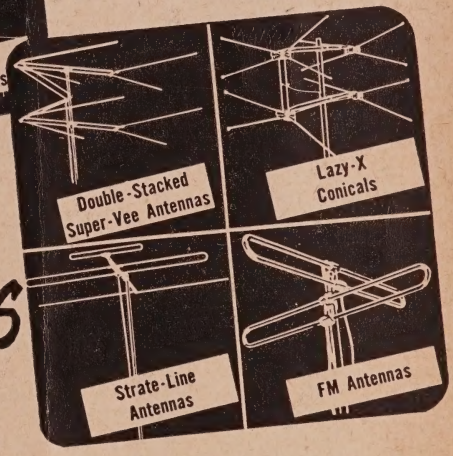

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